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14. ABSTRACT

Corpus Christi Army Depot (CCAD), Corpus Christi, TX inspects the outer mold layer (OML) of the UH-60 Black Hawk helicopter rotor blades for voids and delaminations. This process requires inspection of the blade from fore to aft and from rotor to blade tip. The current inspection process requires a technician to perform a manual "Tap" test of the blade using a small, specialized hammer. During the tapping of the blade, the technician listens for discontinuities in audible sounds produced as the hammer strikes the blade. This discontinuity normally represents a void or delamination. On average, only 4 to 6 blades can be inspected daily. This method may cause unnecessary repairs and/or missed needed repairs. CCAD requested the National Center for Defense Manufacturing and Machining (NCDMM) review the current process and propose a non-destructive test (NDT) method of detecting voids and delaminations utilizing available state-of-the-market equipment.

15. SUBJECT TERMS
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UH-60 BIM Blanket Tap Test Evaluation

NCDMM Project No. 06-0100-07

Technical Report

PROBLEM / OBJECTIVE

Corpus Christi Army Depot (CCAD), Corpus Christi, TX inspects the outer mold layer (OML) of the UH-60 Black Hawk helicopter rotor blades for voids and delaminations. This process requires inspection of the blade from fore to aft and from rotor to blade tip. The current inspection process requires a technician to perform a manual "Tap" test of the blade using a small, specialized hammer (Figure #1). During the tapping of the blade, the technician listens for discontinuities in audible sounds produced as the hammer strikes the blade. This discontinuity normally represents a void or delamination (Figure #2). On average, only 4 to 6 blades can be inspected daily. This method may cause unnecessary repairs and/or missed needed repairs. CCAD requested the National Center for Defense Manufacturing and Machining (NCDMM) review the current process and propose a non-destructive test (NDT) method of detecting voids and delaminations utilizing available state-of-the-market equipment.

Figure #1: Manual Tap Method

Figure #2: Marked Skin-to-Spar Delamination

ACCOMPLISHMENTS / PAYOFF

Process Improvement

Several methods of inspection were evaluated at the NCDMM during the course of the project. The full UH-60 Black Hawk blade used for evaluation contained numerous voids and delaminations mapped out by CCAD technicians utilizing the manual "Tap" test method. The evaluated methods were two (2) digital tapping hammers, two (2) ultrasonic testing systems, two (2) Laser Shearography systems, and a hand held ultrasonic tester with varying success.

Implementation and Technology Transfer

The NCDMM recommends the implementation of a technology termed "Laser Shearography" developed by Laser Technology, Inc. (LTI). Laser Shearography systems use a common path interferometer to image the out-of-plane deformations of the test part surface. The out-of-plane deformations are produced as a response to a change in load on the work piece. This change in load used to create the deformation on the work piece can be created by thermal or pressure stress excitation. In this evaluation, both thermal and pressure systems were reviewed. Both systems provided clear images of structural features and surface/subsurface anomalies. In addition, quantitative data such as defect size, area, and depth can be displayed (Figure #3). The post analysis software package accompanying the system is capable of stitching the individual test pictures together to form a picture of the complete blade surface. Utilizing this advanced technology, the systems accurately detected 100% of the known voids/delaminations present on the blade.

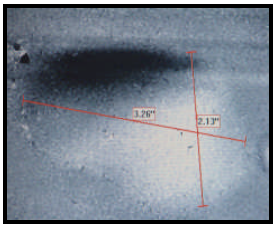

Figure #3: Computer Display of Skin-to-Spar Delamination Represented in Figure #2.

Figure #4: Fully Customizable LTI-9000 Production Vacuum System

Expected Benefits

Shearography systems typically operate at throughputs of 100 to 500 ft^2/hr compared to typical throughput of 10 ft^2/hr for other NDT systems; therefore reducing the per blade inspection time to as little as 30 minutes including set-up. The implementation of Laser Shearography would result in an increase from the stated 4 to 6 blades/day to 44 to 48 blades/day depending on the system configuration chosen. Assuming a shop rate of $100/hr, a $428/blade savings, or $428K/yr can be achieved. Figure #4 illustrates LTI's customizable Production Vacuum System, which the NCDMM is recommending to CCAD for implementation.

TIME LINE / MILESTONE

Start Date.....July 06
End Date.....September 07

PROJECT FUNDING

NCDMM Funding.....$180K

PARTICIPANTS

NCDMM.....Laser Technology, Inc. (LTI)